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AGRICULTURAL MEMORANDUM NO. 640

Dates of Return to Field Capacity in the West of Scotland

by W G Harper

Frequent enquiries are made for meteorological information relating to the return of the soil to field capacity, which is in many cases the main limitation in autumn farming operations. Estimates of excess winter rainfall and excess spring rainfall for 11 stations in the West of Scotland were given in Agricultural Memorandum No. 637, covering the 20 years 1954-73, and the dates of return to field capacity derived from those calculations are examined in this paper. A few stations with shorter periods of record or non-standard periods were included to improve the coverage but it is still rather poor. The north of Argyll and the Western Isles are not covered.

2. The model adopted for extraction of soil moisture was described in Agricultural Memorandum No. 637[1], and was that used in MAFF Technical Bulletin No. 24 for England and Wales[2], in which the validity of estimates of soil moisture deficit is discussed in some detail.

3. In Table 1 are given the mean dates of return to field capacity for the 11 stations. They are given in ranking order of mean date of return, and these show quite a high correlation 0.94 with annual rainfall (R). Annual rainfall averages for the period 1916-50 were chosen deliberately for this comparison because they are widely available in the form of published rainfall maps covering the whole of Scotland. The overall range of mean dates of return is from 4 October at West Freugh in Wigtownshire (R 1015 mm) to 25 June at Eskdalemuir in Dumfriesshire (R 1580 mm). Quartile values for each station are included in Table 1, e.g. at Auchincruive 25 per cent of the dates of return were in or before early September i.e. 5 years in 20, and 25 per cent were in or after early November.

4. Table 2 gives the extreme dates of return to field capacity at each station. At the one extreme, at Eskdalemuir in 6 years in 20, rainfall exceeded potential evapotranspiration in every month and no soil moisture deficit developed. (For the purpose of deriving a mean value the date of return was taken to be 1 April). At the other extreme, in exceptional years in the low rainfall areas of Scotland, though not in the West of Scotland, a deficit of soil moisture may persist throughout an entire winter so that the soil does not return to field capacity.

5. In Table 3 the computed dates of return are given for each year for the 9 stations with complete records for 1954-73.

6. Estimation of dates of return to field capacity for any other station

Estimates of mean date of return to field capacity and of upper and lower quartiles can be obtained from Figure 1 for any other station if its average annual rainfall is known. Alternatively values may be calculated from the following regression equations.

				Correlation with R
Mean date of return	M	=	314 - 0.141 R	-0.94
Upper quartile	B	=	341 - 0.188 R	-0.85
Lower quartile	A	=	323 - 0.115 R	-0.96

where R is in millimetres and M, B and A are given as day numbers with 1 April = 1, 1 May = 31, 1 June = 61, etc. For simplicity each month has been assumed to have 30 days.

7. Comments or suggestions concerning this paper would be welcomed by the author.

References

1. "Excess Winter Rainfall in the West of Scotland", W G Harper, Agricultural Memorandum No. 637, 1974.

2. "The Significance of Winter Rainfall over Farmland in England and Wales", Technical Bulletin No. 24, Ministry of Agriculture, Fisheries and Food, 1971.

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Table 1. Dates of Return to Field Capacity - Means and Quartiles

County	Station (1)	Mean	Quartiles		R mm (2)	Period (3)	Grid Ref	Ht. m
(a) 20-years data 1954-73								
Wigtown	West Freugh	Oct 4	Mid Sep	Early Nov	1015		NX 1155	15
Ayr	Prestwick	Oct 1	Early Sep	Early Nov	935		NS 3626	16
Renfrew	Abbotsinch	Sep 25	Early Sep	Late Oct	1035		NS 4867	5
Ayr	Auchincruive	Sep 23	Early Sep	Early Nov	1000		NS 3924	45
Dumfries	Dumfries	Aug 25	Late Jul	Late Oct	1085		NX 9875	49
Kirkcudbright	Castle Douglas	Aug 11	Late Jun	Early Oct	1170		NX 7963	60
Bute	Rothesay	Jul 30	Early Jul	Mid Sep	1425		NS 0865	43
Dunbarton	Helensburgh	Jul 27	Mid Jul	Late Aug	1465		NS 3084	96
Dumfries	Eskdalemuir	Jun 25	No deficit	Late Aug	1580		NT 2303	242
(b) Stations with limited data or non-standard period								
Argyll	Machrihanish	Sep 25	Mid Sep	Mid Oct	1095	60-73	NR 6623	10
Stirling	Stirling	Sep 15	Late Aug	Mid Oct	1025	43-50) 62-73)	NS 7994	46

Notes: (1) Stations listed in order of mean date of return to field capacity.

(2) Rainfall average 1916-50.

(3) Period of records used if differing from 1954-73.

Table 2. Extreme Dates of Return to Field Capacity

Earliest Return			R mm(3)	Latest Return			R mm(3)
(a) 20-years data 1954-73							
Late Aug	1958	West Freugh	1015	Early Dec	1955	Prestwick	935
Early Aug	1965	Prestwick	935	Late Nov	1955	West Freugh	1015
" "	1958	Abbotsinch	1035	" "	1973	Dumfries	1085
Mid Jul	1954	Auchincruive	1000	Mid Nov	1972	Auchincruive	1000
No deficit	1965	Dumfries	1085	" "	1972	Abbotsinch	1035
" "	1963-5	Castle Douglas	1170	Early Nov	1973	Castle Douglas	1170
" "	1964-5	Rothesay	1425	Late Oct	1972	Rothesay	1425
" "	1954) 1965)	Helensburgh	1465	" "	1972	Helensburgh	1465
" "	1958) 1960) 1962-5)	Eskdalemuir	1580	Mid Oct	1972	Eskdalemuir	1580
(b) Stations with limited data or non-standard period							
Early Jul	1965	Machrihanish	1095	Mid Nov	1972	Stirling	1025
Late Jun	1948	Stirling	1025	Early Nov	1972	Machrihanish	1095

Notes:- (1) Stations listed in order of date of return.

(2) Full details of stations are given in Table 1

(3) Rainfall average 1916-50.

Table 3. Dates of Return to Field Capacity 1954-73 - West of Scotland

Station	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Abbotsinch	Aug 12	Nov 14	Aug 28	Oct 12	Aug 4	Oct 27	Oct 9	Sep 7	Sep 5	Sep 30	Aug 21	Aug 5	Sep 12	Oct 2	Sep 21	Nov 1	Sep 26	Oct 16	Nov 20	Oct 29
Auchincruive	Jul 20	Nov 7	Aug 8	Sep 6	Aug 22	Oct 19	Nov 6	Sep 4	Aug 28	Sep 14	Sep 6	Aug 14	Sep 5	Oct 2	Sep 18	Nov 10	Sep 14	Nov 1	Nov 15	Nov 9
Castle Douglas	Jun 3	Oct 24	Jul 23	Sep 16	Jun 2	Oct 30	Aug 9	Sep 1	Aug 12	X	X	X	Sep 1	Jul 17	Sep 7	Nov 3	Sep 27	Aug 28	Nov 5	Nov 10
Dumfries	May 27	Nov 4	Jul 23	Aug 9	May 28	Oct 29	Aug 29	Sep 9	Aug 16	Aug 5	Aug 27	X	Sep 5	Jul 18	Sep 3	Oct 26	Oct 2	Oct 16	Nov 12	Nov 25
Eskdalemuir	May 4	Sep 22	May 27	Aug 4	X	Oct 10	X	Jul 26	X	X	X	X	Aug 10	Jul 4	Sep 3	Sep 8	Jul 16	May 3	Oct 16	Aug 5
Helensburgh	X	Sep 30	Jul 15	Jul 18	May 2	Oct 6	Jul 8	Jul 26	Aug 9	Aug 6	Jul 13	X	Aug 19	Sep 1	Aug 22	Aug 15	Jul 13	Aug 26	Oct 27	Aug 12
Prestwick	Aug 10	Dec 7	Aug 22	Sep 25	Aug 27	Oct 27	Nov 14	Sep 6	Sep 3	Oct 7	Sep 4	Aug 9	Sep 5	Oct 2	Oct 1	Nov 17	Sep 18	Oct 30	Nov 20	Nov 12
Rothesay	May 5	Sep 29	Jul 19	Jul 24	Jun 3	Oct 7	Jul 14	Jul 15	Aug 11	Jul 12	X	X	Sep 11	Jul 8	Sep 9	Oct 2	Sep 1	Oct 3	Oct 28	Aug 15
West Freugh	Sep 4	Nov 25	Sep 6	Sep 19	Aug 21	Oct 30	Oct 3	Sep 14	Sep 13	Oct 4	Sep 21	Aug 27	Oct 4	Sep 27	Sep 28	Nov 15	Sep 22	Nov 6	Nov 19	Nov 8
Area Mean	Jun 20	Oct 28	Jul 29	Aug 28	Jun 26	Oct 21	Aug 24	Aug 22	Aug 8	Jul 29	Jul 7	May 30	Sep 5	Aug 22	Sep 12	Oct 17	Sep 5	Sep 21	Nov 8	Oct 11

KEY:- X = No soil moisture deficit

E.R.

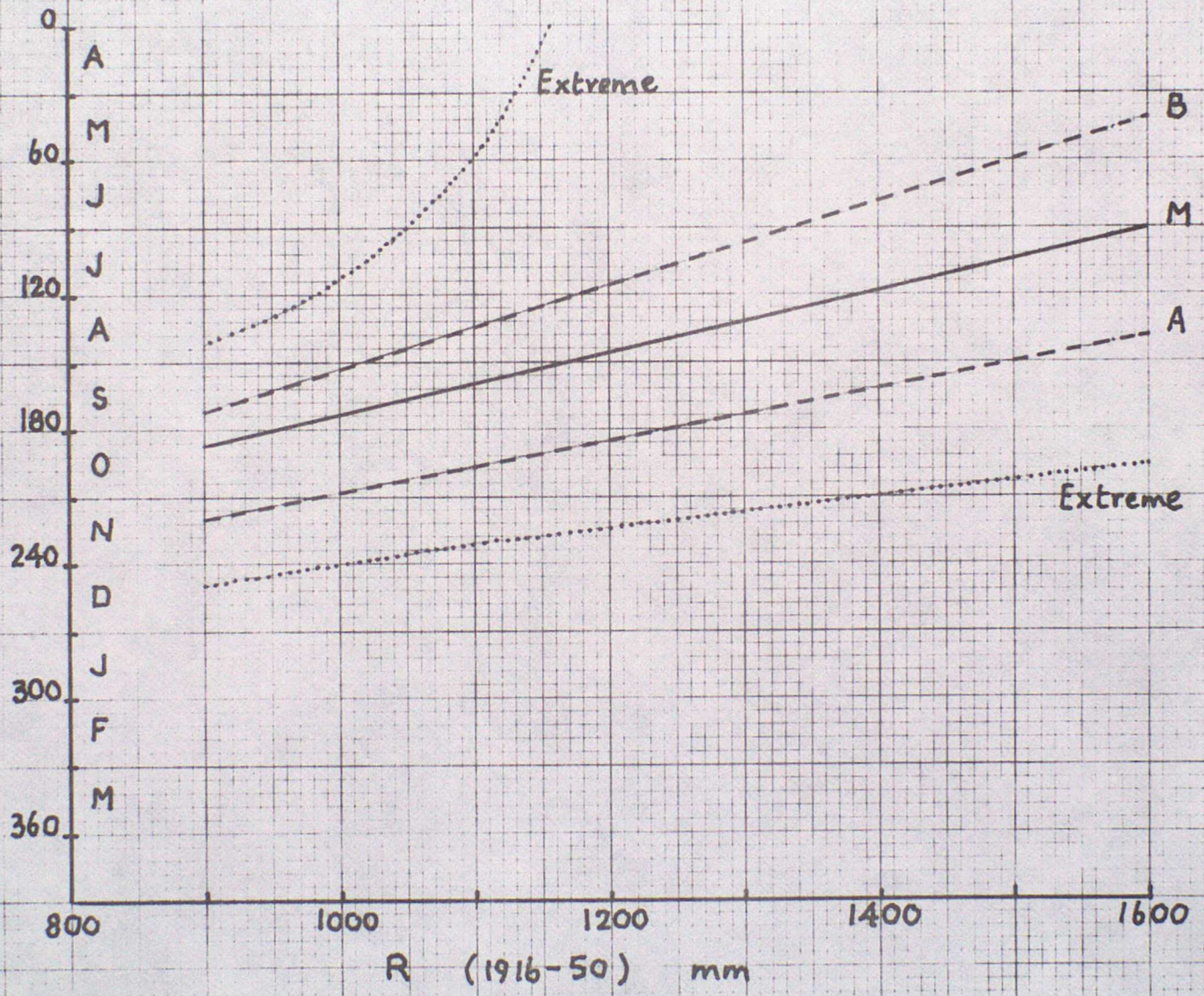

Fig. 1. Date of return to field capacity related to annual average rainfall